
TECHNICAL MEMORANDUM

TO: Passaic River Project

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DATE: October 27, 2015

SUBJECT: Mean Probable Effect Concentration Quotient (mPECq)

Introduction

Calculations were conducted to (1) determine mean probable effect concentration quotients (mPECq) values for 8 background sediment samples and (2) compare the calculated mPECq values to corresponding values determined by NOAA.

Calculation Steps

Calculations were based on: *MacDonald et al (2000), Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems, Arch. Environ. Contam. Toxicol., 39, 20-31*, which provides consensus-based PECs to be used in the calculation. **Table 1** provides the PECs used in this calculation. The database used and the calculations conducted are provided in the attached spreadsheet file:

BG-Seds-CPG-CDM_Analytical_Result_ESS_3.xlsb

The steps conducted were as follows:

1. Concentration data for the corresponding chemicals in Table 1 were extracted from the database and placed into the four groups shown in Table 1. Concentrations below reporting detection limits (RDLs), i.e., nondetects, were not used in the calculations (considered to be zero and ignored during averaging).
2. PECq values were determined for each chemical (concentration divided by PEC).
3. mPECq values were determined as the average PECq for each of the four groups.
4. The overall mPECq was determined as the average of the four mPECq group values.

Table 1
PEC Values Provided by MacDonald et al (2000)

Metals (mg/kg DW)	Consensus-Based PEC
Arsenic	33
Cadmium	4.98
Chromium	111
Copper	149
Lead	128
Nickel	48.6
Zinc	459
PAHs (ug/kg DW)	
Total PAHs	22800
PCBs (ug/kg DW)	
Total PCBs	676
Organochlorine pesticides (ug/kg DW)	
Chlordane	17.6
Dieldrin	61.8
Total DDTs	572
Endrin	207
Heptachlor Epoxide	16
Lindane (gamma-BHC)	4.99

Further details of the calculations are provided by group in the following sections.

Metals

Data for the metals in Table 1 were extracted from the database. The overall mPECq values were then determined for each sample. An example calculation is provided in **Table 2**.

Table 2
Example Calculation for Metals (UPRT18H)

chemical_name	result_numeric	result_unit	PEC	PECq	mPECq
Arsenic	0.95	mg/kg	33	0.03	
Cadmium	0.455	mg/kg	4.98	0.09	
Chromium	12.7	mg/kg	111	0.11	
Copper	31.7	mg/kg	149	0.21	
Lead	73.8	mg/kg	128	0.58	
Nickel	10.5	mg/kg	48.6	0.22	
Zinc	163	mg/kg	459	0.36	0.23

PAHs (Polycyclic Aromatic Hydrocarbons)

Data for the 16 “priority pollutant” PAHs were extracted from the database¹. Concentrations were summed to obtain a total PAH value. The overall mPECq values were then determined for each sample. An example calculation is provided in **Table 3**.

Table 3
Example Calculation for Total PAHs (UPRT18H)

dilution_factor	chemical_name	result_numeric	result_unit	Chemical	Result	PEC	mPECq
10	Acenaphthene	94	ng/g				
10	Acenaphthylene	270	ug/kg				
10	Anthracene	307	ug/kg				
10	Benzo(a)anthracene	840	ug/kg				
10	Benzo(a)pyrene	1290	ug/kg				
1	Benzo(b)fluoranthene	882	ug/kg				
10	Benzo(g,h,i)perylene	785	ug/kg				
1	Benzo(k)fluoranthene	302	ug/kg				
10	Chrysene	1160	ug/kg				
10	Dibenz(a,h)anthracene	194	ug/kg				
10	Fluoranthene	1140	ug/kg				
10	Fluorene	105	ng/g				
10	Indeno(1,2,3-c,d)pyrene	712	ug/kg				
10	Naphthalene	129	ng/g				
10	Phenanthrene	520	ug/kg				
10	Pyrene	1300	ug/kg	Total PAHs	10030	22800	0.44

Note that if analytical results were available with more than one dilution factor, the highest dilution factor was selected for all individual PAHs except for benzo(b)fluoranthene and benzo(k)fluoranthene.

PCBs (Polychlorinated Biphenyls)

Data for the “Total PCB Calculated-2013 RI CDMSmith” values were extracted from the database¹. The overall mPECq values were then determined for each sample. An example calculation is provided in **Table 4**.

Table 4
Example Calculation for Total PCBs (UPRT18H)

chemical_name	result_numeric	result_unit	PEC	mPECq
Total PCB Calculated-2013 RI CDMSmith	56.691343	ug/kg	676	0.084

¹ Consistent with: *Data Usability and Data Evaluation Plan for the Lower Passaic River Study Area Risk Assessments, Final, Windward LLC and AECOM, May 15, 2014*. See Section 4.1.

OCPs (Organochlorine Pesticides)

Data for OCP chemicals were extracted from the database. The overall mPECq values were then determined for each sample. An example calculation is provided in **Table 5**.

Table 5
Example Calculation for Total OCPs (UPRT18H)

chemical_name	result_numeric	result_unit	Chemical	Result	PEC	PECq	mPECq
alpha-Chlordane	3.7	ng/g					
cis-Nonachlor	1.1	ng/g					
Gamma-Chlordane	3.3	ng/g					
trans-nonachlor	3.8	ng/g	Chlordane	11.9	17.6	0.68	
Dieldrin	0.776	ng/g	Dieldrin	0.776	61.8	0.013	
Endrin		ng/g	Endrin		207		
gamma-BHC (Lindane)		ng/g	Lindane (gamma-BHC)		4.99		
Heptachlor epoxide	0.235	ng/g	Heptachlor epoxide	0.235	16	0.015	
o,p'-DDD	0.858	ng/g					
o,p'-DDE	0.141	ng/g					
o,p'-DDT	0.162	ng/g					
p,p'-DDD	2.7	ng/g					
p,p'-DDE	2.3	ng/g					
p,p'-DDT	0.706	ng/g	Total DDTs	6.867	572	0.012	0.18

Results and Discussion

Results of the calculations are provided in **Table 6**, along with the NOAA-determined values for comparison, and summarized graphically in **Figure 1**.

Table 6
Calculation Results

Sample Location	mPECq - Metals	mPECq - PAHs	mPECq - PCBs	mPECq - OCPs	mPECq	mPECq (NOAA)	Abs Diff
UPRT18H	0.23	0.44	0.08	0.18	0.23	0.23	0.00
UPRT18J	0.33	1.33	0.28	0.29	0.56	0.56	0.00
UPRT18K	0.18	1.52	0.11	0.18	0.50	0.50	0.00
UPRT19K	0.18	2.24	0.14	0.27	0.71	0.70	0.01
UPRT20B	0.24	0.40	0.04	0.23	0.23	0.23	0.00
UPRT21C	0.11	0.75	0.05	0.12	0.26	0.26	0.00
UPRT21F	0.20	0.61	0.13	1.00	0.49	0.48	0.00
UPRT22A	0.13	0.06	0.17	0.06	0.10	0.11	0.00

As shown in Table 6 (and Figure 1), the calculated and NOAA-determined mPECq values are essentially an exact match (within rounding error).

